Understanding Helicopter Use in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module

Topic:

FPA's approach to modeling helicopter use in the Initial Response Simulation (IRS) module.

Introduction

FPA must account for helicopter use to adequately model and simulate information in the Initial Response Simulation (IRS) module. Helicopter use in IRS includes delivering:

- Helitack as fireline production resources at a fire event,
- Helitack daily staffing to a fire event, then begin delivering water or retardant to aid in the fire containment effort, Like smokejumpers helitack are put into groups of two or more firefighters to simulate what the FPU would use on any given fire event.
- Water or retardant as part of the fire containment effort.
- As with airtankers, helicopter production with bucket use does not begin until a fire fighting resource is on the modeled fire.

Background

IRS classifies helicopters and helitack as separate producer types so that a helicopter can be available for more than one specific use. Helicopters (HEL1, HEL2, and HEL3) and helitack (HELI) are not always located at the same dispatch location; however, for a helicopter to deliver helitack to a Fire Workload Area (FWA), both the helicopter and helitack Dispatch Locations must be associated with the same FWA. FPU planners assign (using FWA attributes in FPA), whether or not an FWA may use water or retardant for fire containment purposes.

IRS models three helicopter producer types that can deliver helitack, and water or retardant from a Dispatch Location to FWA. Each helicopter producer type has a system-defined capacity of daily staffing/load, gallons/load, and airspeed (see Table 1 for more information). Each producer type capacity varies depending on the elevation of the Travel Time Point (TTP) and the location of the modeled fire event in the FWA. IRS assumes helicopters using bucket-only travel from the Dispatch Location to the FWA TTP with the bucket carried inside the helicopter or on the support truck thus allowing it to travel at a higher speed than if having an external load. The system assigns the number of gallons that each helicopter type can deliver by water/retardant drop and elevation. Airspeed is system assigned by helicopter type.

Type 1, 2, and a few Type 3 Helicopters in FPA are national or regional resources. For guidance in how to consider costs for the helicopters in the analysis, see Modeling National and Regional Resources.

FPU planners must define in the system:

- The total number of Helitack (HELI) fire resources available from each dispatch location. Each HELI should define a total daily staffing.
- Enter in Dispatch Logic the maximum number of helicopters (by producer type) and helitack for each FWA,
- Whether or not water or retardant bucket drops are used in an FWA,
- The Helicopter-Reload Delay for each FWA. Reload Delay is an FWA attribute defined as the time it takes after a helicopter drops its water or retardant to fly to a reload location, refill, and return for the next drop.

Elevation @ Travel Time Point			0'-4,999'		5,000'-5,999'		6,000'-6,999'		7,000'-7,999'		8,000'-8,999'		9,000'-9,999'		10,000'+	
Producer Type	Helicopter Type	Air Speed (MPH)	Daily Staffing	Gallons	Linecutters	Gallons	Linecutters	Gallons	Linecutters	Gallons	Linecutters	Gallons	Linecutters	Gallons	Linecutters	Gallons
HEL1	1	132	18	2012	18	1384	16	1207	16	1142	14	1000	14	898	12	707
HEL2	2	121	9	404	8	299	7	254	7	251	6	211	6	202	4	151
HEL3	3	140	4	247	4	154	4	131	4	123	3	111	3	102	2	81

Table 1: Helicopter Attributes

Discussion

The IRS module design for helicopter producer type follows these assumptions:

- Weight per Gallon of Water = 8.3 lbs.
- Weight per Gallon of Jet Fuel = 7.0 lbs.
- Total fuel onboard = 1.5 hours.
- 10-minute getaway time delay for initial attack.
- Weight per Pilot = 200 lbs.

- Weight per Firefighter = 275 lbs. including gear (185 body weight + 30 for pack + 10 for a tool and 1/2 + 25 for 1/2 saw + 25 for a portion of the empty bucket weight).
- Weight per Rappeller = 300 lbs. including gear (all the same gear weight as a firefighter + an additional 25 lbs. for rappel gear).
- Weight of Spotter = 200 lbs. including gear (185 body weight + 15 lbs. for gear).
- Helicopter Out of Ground Effect (HOGE).
- Helicopter use is limited to civil daylight: there is no helitack, water, or retardant delivery outside of civil daylight.
- Helitack delivered to a modeled fire event can produce fireline until their work shift is completed.

Helicopters Delivering Helitack Daily Staffing

Table 2 describes the time from initial dispatch notification until helitack are producing fireline towards containment on the modeled fire event.

FPA defines Arrival Time for each load of helitack per Fire Workload Area as:

- Mobilization Delay to the FWA Travel Time Point (TTP) + Walk-in Delay + First Unit Delay (applied only to the first unit to arrive) = Arrival Time for each load of helitack per Fire Workload Area.
- FPA system business rules require at least two helitack be assigned to begin producing fireline on a modeled fire event. To accommodate this, a minimum load of 2 helitack from any dispatch location is required. FPUs can add additional helitack in increments of one. If the Dispatch Logic requires more helitack than can be carried in one load of daily staffing, additional loads will be needed. Additional helitack adds to the production rate of the helitack already on the fire.

After the number of helitack assigned in the Dispatch Logic is met, or when no additional helitack are available for dispatch, the helicopter can begin delivering water or retardant, (if the FWA allows the use of water or retardant.). When helicopters are not approved for water or retardant delivery to an FWA, they are available for dispatch to other fire events. If helicopters of different load capability are available for dispatch, FPA uses the helicopter that most closely meets the Dispatch Logic requirement by load capability.

FPA defines a helitack work shift as a consecutive 18-hour shift starting at the time of dispatch minus delays if off shift. After 18 consecutive hours of work, helitack stop fireline production, whether or not the fire is contained. Following a rest period (as defined by the Start hour per day), helitack may resume fireline production at a new fire, or at the previous fire when the fire has not been contained, or has not exceeded the simulation limits.

When daily staffing rappel into an FWA rather than off-loading on the ground, FPUs may adjust that FWAs Walk-in Delay to reflect a more accurate Walk-in Delay value.

Figure 1 shows how IRS handles helitack delivery without water or retardant. Figure 2 shows delivering multiple loads of helitack.

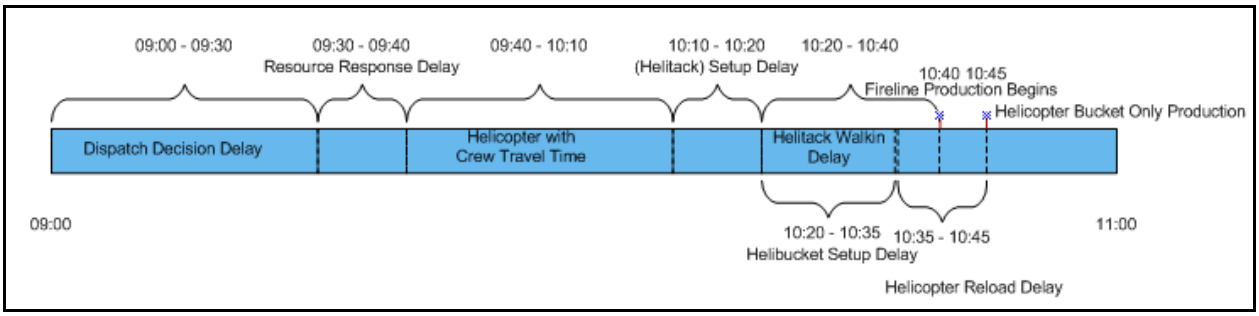


Figure 1: Helitack Delivery and Fireline Production in a Single Load

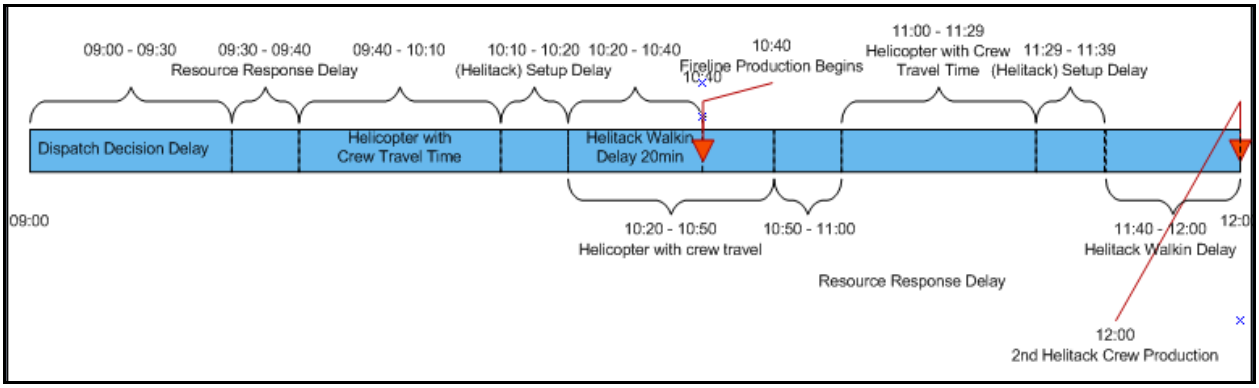


Figure 2: Helitack Delivery and Fireline Production for Multiple Loads

Helitack Delivery from a Dispatch Location Other Than the Helicopter Dispatch Location

When a helicopter is located at a Dispatch Location where helitack are not available or assigned, the helicopter must travel to another dispatch location in order to meet the

FWA's helitack Dispatch Logic requirement. Both the helicopter and helitack dispatch locations must be associated with the FWA where the fire event occurs in order to fulfill the Dispatch Logic requirement.

Under these conditions, IRS calculates the Resource Response Time by:

> Dispatch Decision Delay + Resource Response Delay + Helicopter Travel Time from Dispatch Location to the FWA TTP + Helicopter Travel Time from Dispatch Location to helitack Dispatch Location, to the FWA TTP + Helitack Walk-in Delay = Resource Response Time.

FPA assumes helicopter travel time from its Dispatch Location to the FWA TTP compensates for any helicopter shuttle between Dispatch Locations. When helitack are unavailable at a second Dispatch Location, an FPU must assign additional helitack to meet the Dispatch Logic using the same sequence of events. Figure 3 shows helicopter use when delivering helitack from a different Dispatch Location.

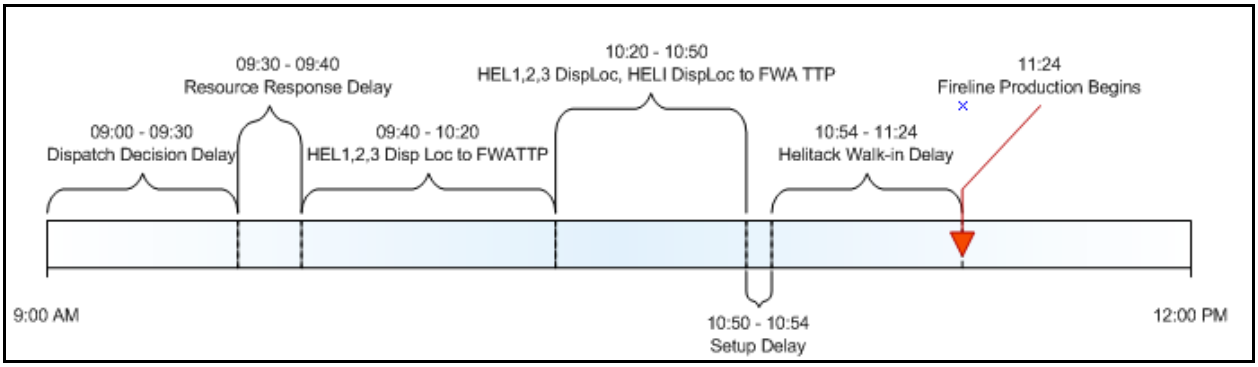


Figure 3: Helicopter Delivering Helitack from a Different Dispatch Location

Helicopter Water or Retardant Delivery Following Helitack Delivery

There is no requirement in FPA for a helicopter to deliver fire fighters prior to starting water and or retardant delivery if another resource is on the ground. After a helicopter has delivered all helitack resources, it may:

- Deliver water or retardant to a modeled fire event (if the FWA allows the use of water or retardant.), or
- Drop water and or retardant without delivering helitack when another resource is already on the ground.

Prior to water or retardant delivery, the helicopter incurs a 15-minute Helicopter-Setup Delay to account for the time it takes a helicopter crew to connect the bucket to the helicopter in preparation for bucket work. The helicopter then begins to deliver water or retardant to the fire. FPU planners enter the helicopter reload time for each FWA. This value represents the time from when the helicopter drops one load of water or retardant and then returns to the fire with another load. Fireline production is one chain of line for each 100 gallons of water or retardant dropped, pending the surface fuel model and the rate of spread of the fire, see Appendix A.

Figure 4 depicts the behavior of delivering helitack resources followed by delivery of water or retardant.

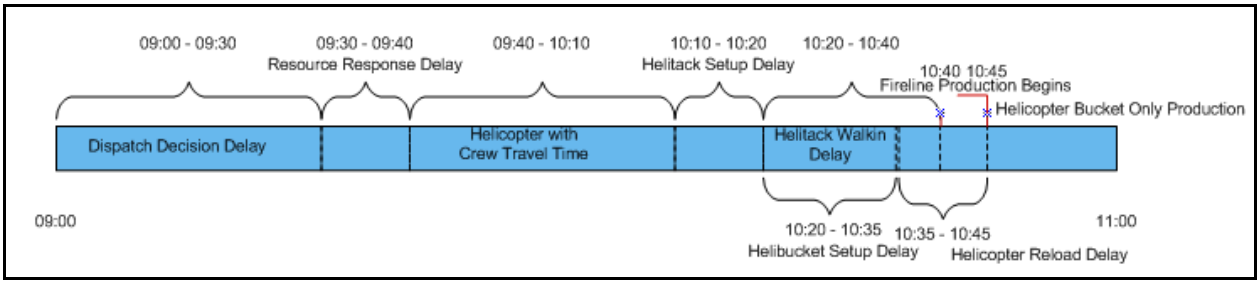


Figure 4: Helitack Delivery Followed by Water or Retardant Delivery

Helicopter Water or Retardant Delivery without Helitack

When the FWA does not allow the use of water or retardant to a fire event, then the helicopter is available for dispatch to other fire events. The system defines the number of gallons of water/retardant available for delivery by elevation for each helicopter producer type.

When an FPU approves water/retardant drops in an FWA, and helitack are not available, or not required in the Dispatch Logic, a helicopter incurs the appropriate delays and begins producing fireline (if and when another firefighting resource is on the ground) based on the number of gallons appropriate for the aircraft type. Figure 5 shows delivery of water or retardant without helitack delivery.

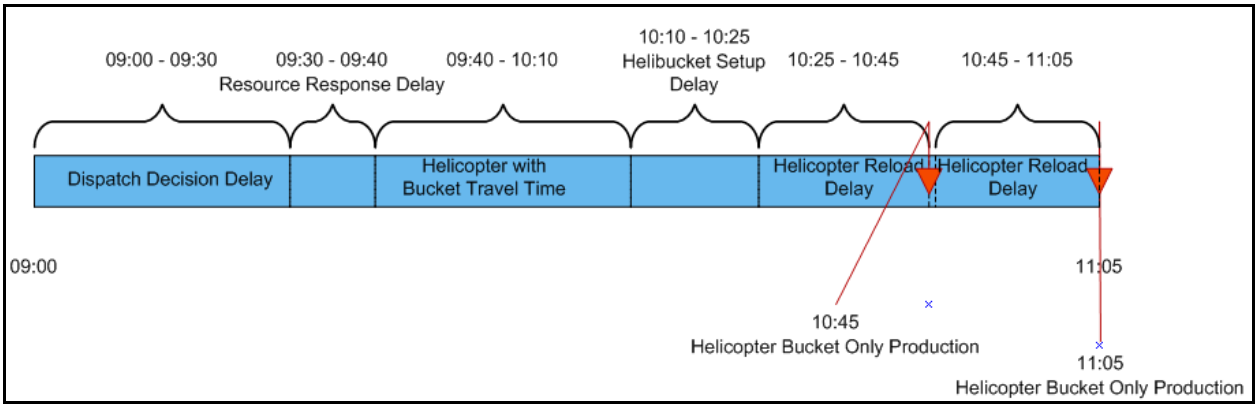


Figure 5: Water or Retardant Delivery without Delivering Helitack

Helicopter Deployment Delays

Delay	Helicopter-Specific Description
Dispatch Decision Delay - The time from fire event discovery, (including time to determine a response strategy), through FPU direction to send resources.	FPA applies a Dispatch Decision Delay of 30 minutes for all fire resources.
Resource Response Delay - The time from when an FPU notifies fire resources to prepare for fire duty until the fire resources leave the Dispatch Location. Only FPA Data Administrator can edit this value.	
Travel Time - The Travel Time between the Dispatch Location and the FWA workload point, excluding delays. The FPA system calculates this value as the distance between Dispatch Location and FWA Travel Time Point based on particular fire resource Producer Type. Travel Time = (distance DL to FWA TTP)/(average travel speed for the fire resource).	Table 1 displays the airspeed by helicopter type information.
Set-up Delay - The time from the end of calculated Travel Time until fire resources are ready to produce or begin walk-in. Examples of Set-up Delay include: • Time to determine a landing spot, land, and unload helitack/ rappellers from a helicopter. • Time it takes for helitack to hookup a bucket to the helicopter.	For helitack, the Set-up Delay represents the time for a set number of rappellers or helitack to exit the aircraft and have their cargo dropped from the helicopter.

Delay	Helicopter-Specific Description
Only FPA Data Administrator can edit this value.	
Helicopter Setup Delay	Prior to water or retardant delivery, the helicopter incurs a 15-minute Helicopter -Setup Delay to account for the time it takes a helicopter crew to connect the bucket to the helicopter in preparation for bucket work.
Helitack Walk-in Delay	An FPU designated time per FWA. It represents the time for helitack resources to walk from a suitable landing zone to the typical initial response fire.

Table 2: Helicopter Deployment Delays

See Also

- Understanding Preproduction Delays in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module
- Understanding Smokejumper Deployment in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module
- Understanding Delays in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module

Appendix A: Aerial Drop Effectiveness Algorithm

Aerial Drop Effectiveness Algorithm

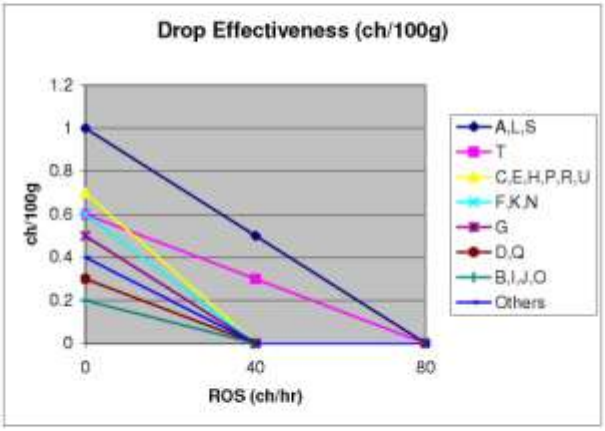
The original aerial drop effectiveness algorithm included a set of linear functions – one for each of several groupings of NFDRS fuel models. Each function had "full effectiveness" when the rate-of-spread (ROS) was zero, and declined to no effectiveness when the ROS was 40 ch/hr or above.

In order to model effectiveness of drops at higher rates-of-spread in grass fuels, the model was subsequently modified to indicate that fuel models A, L, S, and T "zeroed out" at 80 ch/hr instead of 40.

The "full effectiveness", in chains produced by fuel model, was not changed as part of this modification. That effectiveness is shown below:

Fuel Model	Ch/100gal
A,L,S	1
T	0.6
C,E,H,P,R,U	0.7
F,K,N	0.6
G	0.5
D,Q	0.3
B,I,J,O	0.2
Others	0.4

A chart summarizing the effectiveness, as a function of ROS and Fuel Model follows:



B Bowker June 1, 2007

Figure 1: Charting the Aerial Drop Effectiveness Algorithm